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# The introduced barnacle *Balanus glandula* (Darwin) in the Mar del Plata port as a structuring species in the intertidal community[1]

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**ABSTRACT.** The paper deals with the distribution pattern and population dynamics of the introduced barnacle *Balanus glandula* in the intertidal areas of Mar del Plata port. The reproductive cycle of this barnacle is discussed as a community structuring force. Replicated areas in both the high intertidal and the upper mid intertidal zones were monthly denuded. The recruitment, cumulative settlement, mortality and growth of *B. glandula* were recorded, as well as the succession pattern of the associated fauna. First settlement of *B. glandula* occurred in winter (July). Succession begins with a film of microorganisms followed by green algae (*Ulva lactuca* and *Enteromorpha spp.*) which dominate up to a final stage of *B. glandula* dominated community is reached all along the intertidal. *B. glandula* densities were significantly higher in the mid intertidal than in the high intertidal (19600 and 13600 ind. m-$^{2}$, respectively). Annual mean mortality was high in the port (up to 62%) but heavy settlement allowed a final density 4 times greater than in the upper mid intertidal of exposed rocky shores, and twice the greatest density reached in the Northern Hemisphere. Winter reproduction of *B. glandula*, absence of predators, and the neutral or beneficial effect of algae allows this species to occupy in wave protected areas the whole intertidal zone, displacing the former *B. amphitrite* populations from the intertidal to the subtidal. In exposed rocky shores the species outcompete mussels from the high intertidal, establishing the typical barnacle fringe.

**Key words:** *Balanus glandula*, intertidal, successional pattern, port, Southwestern Atlantic.

## El cirripedio introducido *Balanus glandula* (Darwin) en el puerto de Mar del Plata como una especie estructurante de la comunidad intermareal

**RESUMEN.** Se analiza la dinámica poblacional del cirripedio introducido *Balanus glandula* en el área intermareal del puerto de Mar del Plata. El ciclo reproductivo de este cirripedio es discutido como una fuerza estructurante de la comunidad. Áreas replicadas, tanto en el intermareal alto como en la parte superior del intermareal, fueron mensualmente desnudadas. El reclutamiento, asentamiento acumulativo, mortalidad y crecimiento basal medio de *B. glandula* fue registrado, al igual que la sucesión de la fauna asociada. El primer asentamiento se registró en invierno (julio). La sucesión comenzó con un film de microorganismos, seguido por algas verdes (*Ulva lactuca* y *Enteromorpha spp.*) que dominaron hasta una comunidad final dominada por *B. glandula* a lo largo de todo el intermareal. La densidad de *B. glandula* fue significativamente más alta en la parte superior del intermareal medio que en el intermareal alto (19.600 y 13.600 ind. m-$^{2}$, respectivamente). La mortalidad anual media fue grande en el puerto (más del 62%), pero elevados asentamientos permitieron una densidad final 4 veces mayor respecto a la zona rocosa expuesta al oleaje y dos veces superior a la mayor densidad alcanzada en el hemisferio norte. La reproducción invernal de *B. glandula*, la ausencia de predadores y el efecto benéfico o neutral de algas, permiten a esta especie ocupar la totalidad del intermareal, desplazando a las poblaciones de *B. amphitrite* del intermareal al submareal. En el intermareal rocoso expuesto al oleaje, la especie excluye a los bivalvos sólo del intermareal alto, formando la clásica franja de cirripedios.

**Palabras claves:** *Balanus glandula*, intermareal, patrón sucesional, puerto, Atlántico sudoccidental.

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## INTRODUCTION

The original descriptions of the intertidal rocky shore communities of Mar del Plata (38º02'S, 57º32'W) showed the total absence of barnacles from the intertidal zone. This pattern was also typical from others intertidal rocky shores of the Southwestern Atlantic coasts (Ringuelet *et al*., 1962; Olivier *et al*., 1966a, 1966b) and also for some places of México and Venezuela (Rodríguez, 1959, 1963; Villalobos, 1960; Nonato and Peres, 1961; Rodriguez da Costa, 1962 in Olivier *et al*., 1966b).

In the late 60's barnacles colonized the port of Mar del Plata (Bastida, 1968), and expanded to the natural surroundings rocky shores (Bastida, 1971a; Penchaszadeh, 1973; Spivak *et al*., 1975). Thereafter the intertidal zone at the port was dominated by *Balanus amphitrite amphitrite* (Darwin), with small patches of *Brachidontes rodriguezi* (Bastida *et al*., 1971). Successive studies showed that barnacle dominance persisted (Bastida, 1971a; b; Spivak *et al*., 1975; Bastida *et al*., 1980). Today, *B. amphitrite* recruit and is dominant on subtidal panels at the port (Pezzani *et al*., 1994), while recruitment seems to occur often also in the intertidal. However, Spivak *et al*. (1975) detected in the intertidal areas of the port another unidentified dominant species of *Balanus*. In 1974 *B. glandula* was identified from the waterline of experimental panels placed in the port (Bastida *et al*., 1980). Further studies showed that this species occupied all the intertidal areas of the port (Elias *et al*., 1993; Vallarino and Elias, 1997).

*Balanus glandula* is a prominent barnacles on the high intertidal communities on the Pacific rocky coasts, from Baja California to Alaska (Morris *et al*., 1980 in Gaines *et al*., 1985; Foster *et al*., 1991), but there is no information on their populations dynamics in the South Atlantic coasts. The goal of the present study was to contribute to understanding on how could this species colonize an area previously occupied by another barnacle. In order to do so, we studied the patterns of recruitment, growth, and mortality of *Balanus glandula* in the sheltered rocky shores of Mar del Plata Port, and followed the community succession pattern. We also discuss how this species has affected the intertidal community structure.

## MATERIAL AND METHODS

From January to December of 1991 four sampling units of 100 $cm^2$ each were monthly denuded in the inner part of the north breakwater of Mar del Plata Port (Fig. 1). One pair of sampling units was located in the High Intertidal (HI) and the other pair in the Upper Mid Intertidal (UMI). Irregular quarcitic blocks introduced from surrounding sites and located in breakwaters like structures compose this sheltered intertidal area.

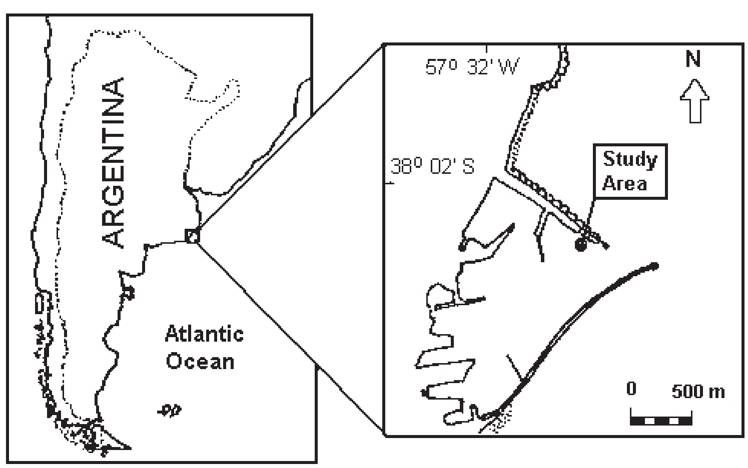


**Figure 1. Location of sampling site in the inner part of the north breakwater of the Mar del Plata Port (sheltered area).**

**Figura 1. Ubicación del sitio de muestreo en la parte interna de la escollera norte del puerto de Mar del Plata (área protegida).**

Denuded areas were controlled monthly, by superposing a plastic film with 100 random points to detect percent cover and settlement time of *Balanus glandula*, other barnacle species, and associated macrofauna (Connell, 1970). For associated macroflora relative percent cover was assessed according to the following categories: 1, 0-25%; 2, 26-50; 3, 51-75; 4, 76-100 of total surface area covered

For detecting changes in the population parameters of *Balanus glandula* other 4 fixed sampling units (two at the HI, and two at the UMI) were denuded in January 1991 and controlled monthly until March 1992. We were not able to measure cyprid settlement, so the censuses were carried out in barnacles >0.5 mm in basal diameter (recruits). Barnacle recruitment, cumulative recruitment (surving individuals from one month to the next), and mortality were determined monthly. Growth was measured by drawing the basal diameter of each individual every month on a plastic film (following Connell, 1961). Differences between means number of recruits, cumulative recruitment and growth were compared with “a priori” test (orthogonal contrast) in a simple ANOVA test design.

## RESULTS

The successional pattern began with the establishment of a initial microfilm, wich was observed but not quantified. Green algae (mainly *Ulva lactuca* (L) and some *Enteromorpha* spp.) colonized all the denuded space throughout the year in both the High Intertidal (HI) and the Upper Mid Intertidal (UMI) (Tables 1 and 2). The pulmonate limpet *Siphonaria lessoni* Blainville migrated into the denuded area, reaching high relative cover, although this species prefers the edge of denuded areas than the areas themselves, so its occurrence was occasional and the data were not included in the present study. The only intertidal barnacle species present was *B. glandula*, except for a few barnacles of uncertain identification (perhaps *B. improvisus*) that settled in sampling units in April, but died whiting the first month.

Most areas denuded between January and June

**Table 1. Relative percent cover of *Ulva lactuca – Enteromorpha* spp. in the high intertidal of the Mar del Plata port in 1991.**

**Tabla 1. Porcentaje de cobertura relativa de *Ulva lactuca – Enteromorpha* spp. En el intermareal alto del puerto de Mar del Plata en 1991.**

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| B | | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 4 | 4 | 4 |
| | C | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | D | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 4 | 4 | 4 |
| | | E | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | F | | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| | | | G | 2 | 1 | 1 | 1 | 2 | 3 | 4 | 4 |
| | | | H | 2 | 1 | 2 | 2 | 2 | 4 | 2 | 4 |
| | | | | I | 1 | 1 | 1 | 2 | 3 | 4 | 4 |
| | | | | J | 1 | 1 | 1 | 1 | 2 | 3 | 4 |
| | | | | | K | | | 1 | 4 | 4 | 4 |
| | | | | | L | | | 1 | 4 | 4 | 4 |
| | | | | | | M | | 1 | 1 | 2 | 2 |
| | | | | | | N | | 1 | 1 | 1 | 1 |
| | | | | | | | O | | 1 | 4 | 4 |
| | | | | | | | P | | 2 | 4 | 4 |
| | | | | | | | | Q | | | 1 |
| | | | | | | | | R | | | 1 |
| | | | | | | | | | S | | 1 |
| | | | | | | | | | T | | 1 |
| | | | | | | | | | | U | |
| | | | | | | | | | | V | |
| | | | | | | | | | | | W |
| | | | | | | | | | | | X |

**Table 2. Relative percent cover of *Ulva lactuca* – *Enteromorpha* spp. in the upper mid intertidal of the Mar del Plata port in 1991.**

**Tabla 2. Porcentaje de cobertura relativa de *Ulva lactuca* – *Enteromorpha* spp. En la parte superior del intermareal medio del puerto de Mar del Plata en 1991.**

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | 4 | 4 | 4 | | | | | | | |
| B | | | 1 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |
| | C | | | | | | | | | | |
| | D | 1 | 2 | 3 | 3 | 4 | 4 | 4 | 3 | 4 | 4 |
| | | E | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 4 | 4 |
| | | F | | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 4 |
| | | | G | | 1 | 1 | 1 | 2 | 3 | 3 | 4 |
| | | | H | | 1 | 2 | 4 | 4 | 4 | 4 | 4 |
| | | | | I | 1 | 1 | 2 | 3 | 4 | 4 | 4 |
| | | | | J | 1 | 1 | 2 | 4 | 4 | 4 | 4 |
| | | | | | K | | | 1 | 4 | 4 | 4 |
| | | | | | L | | | 1 | 4 | 4 | 4 |
| | | | | | | M | | 1 | 2 | 4 | 4 |
| | | | | | | N | | 1 | 2 | 4 | 4 |
| | | | | | | | O | | 1 | 2 | 2 |
| | | | | | | | P | | | 4 | 4 |
| | | | | | | | | Q | | 2 | 2 |
| | | | | | | | | R | | 2 | 2 |
| | | | | | | | | | S | | 1 |
| | | | | | | | | | T | | 1 |
| | | | | | | | | | | U | |
| | | | | | | | | | | V | |
| | | | | | | | | | | | W |
| | | | | | | | | | | | X |

**Table 3. Relative porcent cover of *Balanus glandula* in the high intertidal of Mar del Plata Port in 1991. The + symbol represent presence of juvenile barnacles lesser than 0.5 mm in basal diameter.**

**Tabla 3. Porcentaje de cobertura relativa en 1991 de *Balanus glandula* en el intermareal alto del puerto de Mar del Plata. El símbolo + representa la presencia de juveniles de menos de 0,5 mm en diámetro basal.**

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | | | | | | | | | 2 | 4 |
| B | | | | | | | 1 | 2 | 1 | 2 | 5 |
| | C | | | | | | 5 | 10 | 23 | 25 | |
| | D | | | | | | 2 | | 2 | 2 | 11 |
| | | E | | | | | 2 | | 6 | 4 | 8 |
| | | F | | | | | + | 4 | 5 | 6 | 1 |
| | | | G | | | | + | | 3 | 4 | 3 |
| | | | H | | | | + | | 3 | 6 | 5 |
| | | | | I | | | | | 5 | 6 | 9 |
| | | | | J | | | | | 1 | 3 | 7 |
| | | | | | K | | | | 2 | 7 | 7 |
| | | | | | L | | | 1 | 2 | 3 | 7 |
| | | | | | | M | | | | 2 | 4 |
| | | | | | | N | | | 2 | | 2 |
| | | | | | | | O | | + | 1 | |
| | | | | | | | P | | + | | |
| | | | | | | | | Q | | | |
| | | | | | | | | R | | | |
| | | | | | | | | | S | | |
| | | | | | | | | | T | | |
| | | | | | | | | | | U | |
| | | | | | | | | | | V | |
| | | | | | | | | | | | W |
| | | | | | | | | | | | X |

**Table 4. Relative percent cover of *Balanus glandula* in the upper mid intertidal of Mar del Plata Port in 1991. The + symbol represent presence of juvenile barnacles lesser than 0.5 mm in basal diameter.**

**Tabla 4. Porcentaje de cobertura relativa de *Balanus glandula* en la parte superior del intermareal medio del puerto de Mar del Plata en 1991. El símbolo + representa la presencia de juveniles de menos de 0,5 mm en diámetro basal.**

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | | | | | | | | | | |
| B | | | | | | | | | 1 | 1 | 5 |
| | C | | | | | | | | | | |
| | D | | | | | + | 1 | | 20 | 28 | |
| | | E | | | | + | 2 | | 9 | 10 | 19 |
| | | F | | | | 2 | 4 | 9 | 22 | 28 | 28 |
| | | | G | | | | + | + | 18 | 20 | 25 |
| | | | H | | | 3 | 8 | | 33 | 35 | 38 |
| | | | | I | | | + | 2 | 9 | 5 | 21 |
| | | | | J | | | 2 | 4 | 7 | 10 | 14 |
| | | | | | K | | | + | 9 | 7 | 3 |
| | | | | | L | | | 2 | 2 | 5 | 4 |
| | | | | | | M | | | | 3 | 2 |
| | | | | | | N | | | | 1 | 5 |
| | | | | | | | O | | + | + | + |
| | | | | | | | P | | + | + | + |
| | | | | | | | | Q | | | |
| | | | | | | | | R | | | |
| | | | | | | | | | S | | |
| | | | | | | | | | T | | |
| | | | | | | | | | | U | |
| | | | | | | | | | | V | |
| | | | | | | | | | | | W |
| | | | | | | | | | | | X |

1991 were colonized by *B. glandula* between July-September. Areas denuded in late winter or spring were scarcely colonized by *B. glandula* or not colonized at all, suggesting that rocky substrata needs at least two winter months of initial film development to became attractive for a barnacle settlement. Rate of recruitment was variable between and within tidal levels.

Recruitment showed no statistical differences between tidal levels, with a peak in July-September (Fig. 2, Table 5). Cumulative recruitment increasing sharply during the first months, with no differences

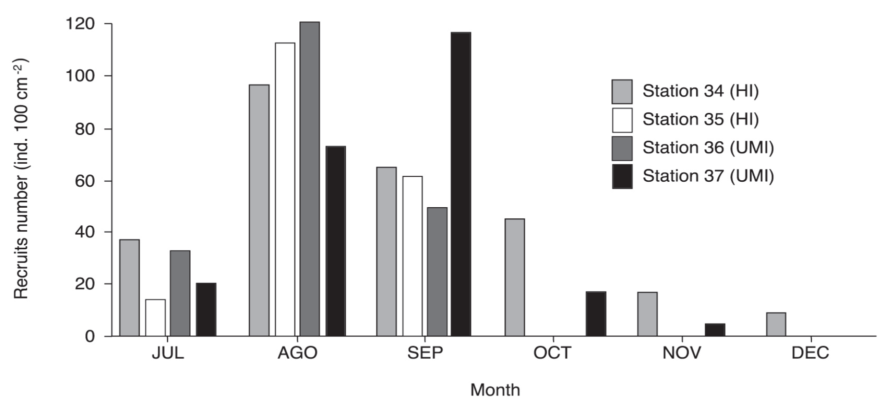


**Figure 2. Recruitment of individuals of *Balanus glandula* (0.5 mm in basal diameter) in the high intertidal (HI, Sations 34-35) and upper mid intertidal (UMI, St. 36-37) of the Mar del Plata port.**

**Figura 2. Individuos reclutados de *Balanus glandula* (0,5 mm de diámetro basal) en el intermareal alto (HI, Estaciones 34-35) y parte superior del intermareal medio (UMI, Estaciones 36-37) en el puerto de Mar del Plata.**

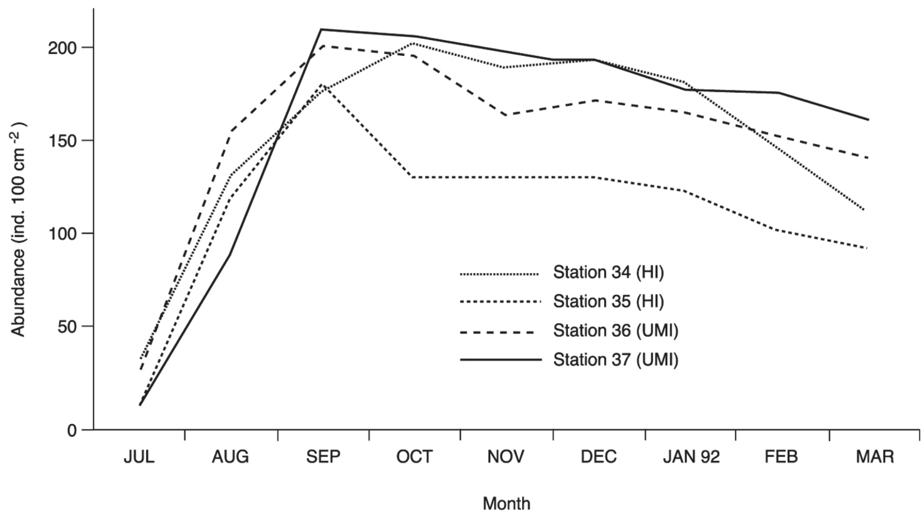


**Figure 3. Cumulative recruitment of *Balanus glandula* in the high intertidal (HI, St. 34-35) and upper mid intertidal (UMI, Stations 36-37) of the Mar del Plata Port.**

**Figura 3. Asentamiento acumulativo de *Balanus glandula* en el intermareal alto (HI, Estaciones 34-35) y parte superior del intermareal medio (UMI, Estaciones 36-37) en el puerto de Mar del Plata.**

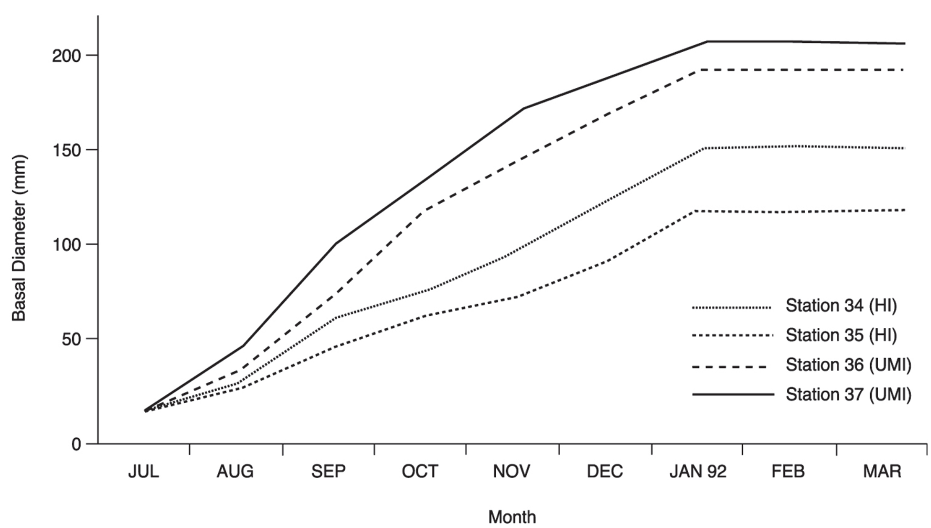


**Figure 4. Mean basal diameter of *Balanus glandula* as a function of time in the high intertidal (HI, St. 34-35) and upper mid intertidal (UMI, Stations 36-37) of the Mar del Plata Port.**

**Figura 4. Diámetro basal medio de *Balanus glandula* en función del tiempo en el intermareal alto (HI, Estaciones 34-35) y parte superior del intermareal medio (UMI, Estaciones 36-37) en el puerto de Mar del Plata.**

**Table 5. Analysis of variance. Orthogonal contrast in the Mar del Plata port. HI: high intertidal, UMI: upper mid intertidal. ns: no significative; ** p < 0.01**

**Tabla 5. Análisis de Varianza. Contrastes ortogonales en el puerto de Mar del Plata. HI: intermareal alto; UMI: parte superior del intermareal medio. ns: no significativa; ** p < 0,01**

| SOURCE | SUM | Fd | F |
|---|---|---|---|
| Recruitment HI vs. UMI | 100 | 1 | 0.07 ns |
| Cumulative Recruitment HI vs. UMI | 41412.25 | 1 | 3.54 ns |
| Mean Basal Growth HI vs. UMI | 2762.5 | 1 | 127.2 ** |

$F_{0.05}$= 4.00
$F_{0.01}$= 7.08

between HI and UMI (Fig. 3, Table 5). The growth of *B. glandula* was higly significative different in the two levels (Fig. 4, Table 5). At high densities, basal growth was practically null due to crowding and individual grew in height rather than in width.

During spring (October-December) mean mortality reached values between 3.4 and 21%, but being great in autumn (March) with a maximum of 23% of total individuals. Mean cumulative mortality was different between the HI (62,1%) and the UMI (27,1%). However, mortality appeared to have little effect on the *B. glandula* population due to the high final densities, between 13600 to 19600 ind. $m^{-2}$, reaching densities several times greater than in the Northern Hemisphere.

## DISCUSSION

Recruitment of *Balanus glandula* occurs during winter months (July) in the Mar del Plata Port area. First record for colonization by *B. glandula* were reported in 1974, when they settled in artificial panels between August to November, with a maximum in September (Bastida *et al*., 1980). This pattern was also reported for open sea rocks (Spivak and L'Hoste, 1976; Nugent, 1986; Vallarino and Elías, 1997). Isolated individuals of *B. glandula* covering 0.03% of intertidal substrata (an abrasion platform) near a sewage was recorded in autumn and winter, 200 km south of Mar del Plata (Lopez Gappa *et al*., 1993).

During winter month, mean water temperature decrease from 17 to 8ºC in the Mar del Plata port (Bastida, 1971a, 1971b; Lopez Gappa *et al*., 1993). In British Columbia *B. glandula* spawns twice between May-September (Wu and Levings, 1979), when water temperature is 9-14ºC (Dill and Gillett, 1991). Foster *et al*. (1991) mention for the Northeast Pacific a mean water temperature along the coast (N-S) from 7.9 to 17.9º C. So the spawning period in Mar del Plata area occurs in a similar range of temperature. Hines (1978) mentions that in British Columbia and Southern California this species broods during late fall and early winter, and that cold water temperature is necessary for trigged the reproduction.

The winter recruitment in the Mar del Plata area suggests a breeding season approximately in June-July. In Blanca Bay estuary a winter-spring larval peak of *Balanus glandula* was observed in the plankton, but no time fixation was established (Wagner *et al*., 1991). The larvae of *Balanus glandula* in Northern Hemisphere are estimated to be in the plankton for approximately 3 to 4 weeks (Brown and Roughgarden, 1985). Initial larvae release by *B. glandula* adults is generally in early spring (Connell, 1970; Gaines *et al*., 1985), or with two spawning periods between May-September (Wu and Levings, 1979).

Variation of recruitment density of *Balanus glandula* among different habitats can be considered as a combination of two processes, planktonic larval supply and water movement. Gaines *et al*. (1985) suggest that settlement density variation is more likely to be a function of planktonic larval supply other than of characteristics of either the local water column or substratum. Grosberg (1982) demonstrated that cyprids of *B. glandula* are zoned even before settlement, and within their ranges of planktonic zonation, larvae may still select substrata. Bastida *et al*. (1980) also suggested this pattern for barnacle larvae in Mar del Plata Port. On the other hand, variations in rate of settlement on closely adjacent areas were also great in the study carried out by Connell (1961).

In Mar del Plata area mortality reached high values in sites with heavy recruitment (high vs low tidal levels). Population structure of *Balanus* *glandula* in central California differs between locations of high and low larval settlement rate. At the low settlement locations mortality of barnacles is independent of the area, while at high settlement locations mortality is cover-dependent due to increased predation by starfish on areas of high barnacle cover (Gaines and Roughgarden, 1985). On the other hand, *B. glandula* recruited throughout much of the intertidal zone in Washington, but at lowest levels they die within 1 year, mainly due to predation, before reaching adulthood (Connell, 1970), and mortality was density independent at both high and low shore levels (Connell, 1985). However, the absence of both predators and interspecific competence in the Mar del Plata port suggest the existence of a denso-dependent relationship in the high level (barnacle fringe) of this intertidal zone.

Relative basal growth was highly different between HI and UMI. However, in both levels, crowding interrupted the basal growth, and individuals became taller. These crowded barnacles developed an elongate morphology that is more susceptible to disturbance (Grant, 1977). Large disturbance results since barnacles are attached to each other wash off in clumps (Farrell, 1989). Although the port is a sheltered area, autumn and winter storms and the high densities of barnacles may create bare space in barnacles crowded rocks, allowing the next recolonization cycle.

**Community pattern**

Barnacles have an aggressive behavior in hard substrates occupation by ship-borne populations (remote dispersal), or larval natural drift along the coast (marginal dispersal) (see Lewis, 1976), and constitute the most common marine species invading harbors worldwide.

The successful introduction of the barnacles *Balanus amphitrite* and *B. trigonus* (Darwin) in the Mar del Plata port could be considered as examples of remote dispersal, and have been attributed to their tolerance to organic enrichment and water turbidity (Bastida, 1971a; Bastida *et al*., 1971). The settlement of *B. amphitrite* and *B. trigonus* occurs in the port during January (summer), when water temperature reaches 20ºC. The heaviest recruitment of these species occurred in mid-February (with a mean density of 122 ind. m-$^{2}$) and in mid-January (25 ind. m-$^{2}$), respectively (Bastida *et al*., 1980), but both disappeared during June (Bastida, 1971a, 1971b). Although *B. amphitrite* can attained 5 cm width in summer months (Bastida 1971a, 1971b), the winter reproductive cycle of *B. glandula* allows it to settled and reach a similar size at summer time, when other barnacle settle, and occupied the available space with a high density.

In exposed rocky shores of Southern California mean density of *B. glandula* was reported to reach 205 ind. m-$^{2}$ (Littler *et al*., 1991), and a recently study reported a maximum of 7000 ind. m-$^{2}$ (Lohse, 1993), half of the densities found in the Mar del Plata port. This density can be attributed to a larger larval availability and a lower water movement in the port which is likely to produce heavier settlement. Other factor to be considered is that *B. glandula* can persist in spatial refuges in sheltered intertidal of the port due to their tolerance to physical stress (including pollution) and the absence of both predators and interspecific competence (Stephens and Bertness, 1991).

The main space competitor of *B. amphitrite* and *B. trigonus* in the waterline of Mar del Plata Port was the green algae *Enteromorpha intestinalis* (L.), while the pulmonate limpet *Siphonaria lessoni* browsing create bare space for barnacle colonization (Bastida, 1971a). Although *Enteromorpha* has an annual cycle, their colonization is interrupted during cold months (Bastida, 1971b; Bastida *et al*., 1980). Limpets could also reduce the density of barnacle settlement or damage young barnacles by detachment (bulldozing effect or running over) (Dayton, 1971; Miller and Carefoot, 1989; Safriel *et al*., 1994). However, a preliminary study in the intertidal areas of the port shows no significative interactions between *S. lessoni* and *B. glandula* population, due to the capacity of the limpet to raise the vertical wall of barnacles, avoiding the bulldozing effect (Elias *et al*., 1993).

In Mar del Plata area, canopy algae were absent. The opportunistic green algae in the port, and the red encrusting algae *Hildenbrandia* in exposed rocky shores (Playa Grande beach) seem to have a neutral or a beneficial effects on the *B. glandula* population. However other studies have shown barnacle reduction due to algal frond whipping (Menge, 1976; Grant, 1977) or inhibition of *B. glandula* settlement by mucus or an unsuspected negative cue associated with algal mucus (Jonhson and Strathman, 1989). In fact, *H. lecanellieri* Harriot has been mentioned as a seral stage in the successional pattern of the exposed rocky intertidal community (Penchaszadeh, 1973; Nugent, 1986).

In summary, predator absence, no negative interactions with algae or limpets, wave-caused disturbance, growth, and recruitment pattern relationships allow *Balanus glandula* to successfully colonize Mar del Plata Port area. On exposed rocky shores *B. glandula* displaced the *Brachidontes-Mytilus* community only from the high intertidal (barnacle fringe), because mytilids are better competitors in the mid intertidal (Vallarino and Elías, 1997), while in the Port they became dominant all along the intertidal, displacing the former invading (barnacles *Balanus amphitrite* and *B. trigonus*) to the subtidal.

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